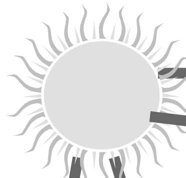
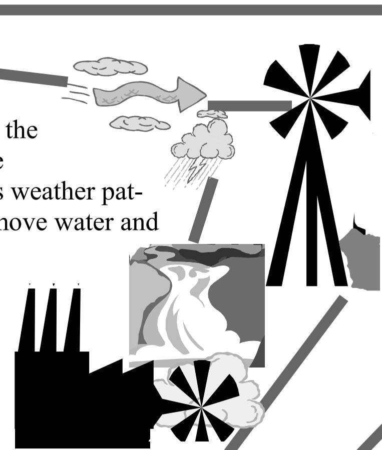
All energy comes from the sun

Trace its path to the light switch!



Last spring we traced the sun's energy through plants and animals that feed us. Here you can follow the green lines of the sun's energy to the electricity that powers our lights.

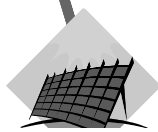


The sun is the heat source that creates weather patterns that move water and wind

Last spring we looked at how the sun's energy grows food to give us energy to ride bikes.

Bicycles can be used to generate electricity. With a bicycle generator, one hour of pedaling produces 100 watt hours of electricity.

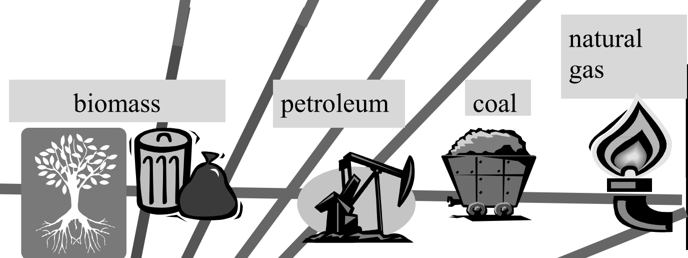
How long would you have to pedal to keep your room lit at night?



The sun gives solar panels light energy to turn into electric energy.

How long would you have to pedal to watch your favorite TV show?

Energy Patrol hint: Read the electric nameplate on your TV to see how much electricity your TV uses. Multiply your TV's watts by how many hours you watch TV and divide that by 100. Your answer is how many hours it would take to self power your TV.



The sun grows trees whose wood is used to generate steam for biomass generation plants.

The sun grew the plants that fed dinosaurs and with them became today's fossil fuels. When burned, fossil fuels can heat water whose steam drives turbines.

When we burn fossil fuels, we burn **carbons** that were buried with dinosaurs and plants a long time ago. **Carbon** dioxide and **carbon** monoxide are two pollutants produced by burning fossil fuels.

As electricity travels from its source to its use, 30% of the energy is lost in the process.

Using Maine's energy mix:

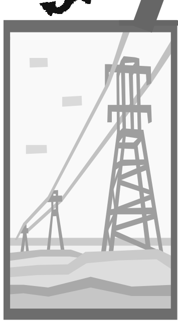
One 15 watt cfl bulb saves 55 acres of carbon sink in its lifetime.

One 23 watt cfl bulb saves 94 acres over its lifetime.

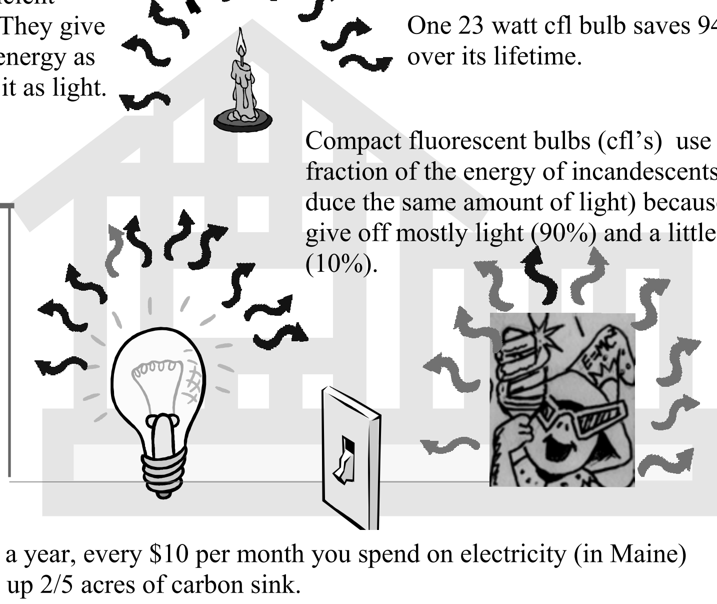
Candles are inefficient sources of light. They give off most of their energy as heat and some of it as light.

Black arrows represent heat given off.
Grey arrows represent light given off.

Compact fluorescent bulbs (cfl's) use only a fraction of the energy of incandescents (to produce the same amount of light) because they give off mostly light (90%) and a little heat (10%).



Incandescent light bulbs give off 90% heat and 10% light, so they use the energy of 3 compact fluorescents.



Over a year, every $10 per month you spend on electricity (in Maine) takes up 2/5 acres of carbon sink.

FOOTPRINTS: Measuring the ecological impact of our lives

What is an Ecological Footprint?

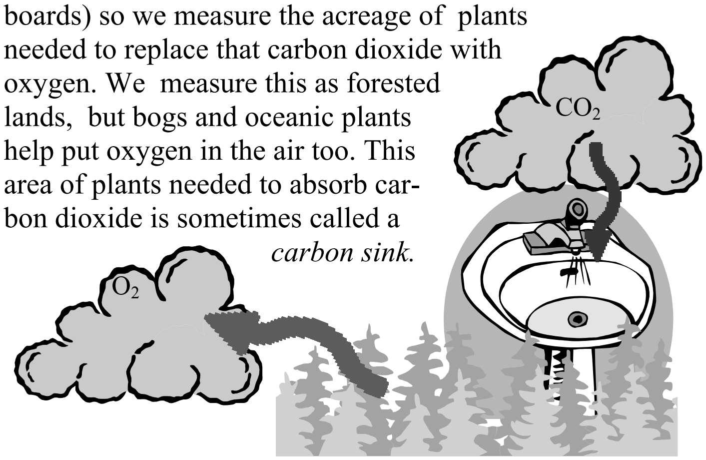
When we think of trackers reading a trail of prints, the track, or "footprint" is evidence of what animals have passed, what they were doing and when. An **Ecological Footprint** is a measure of the evidence that we humans leave behind when we use energy.

An Ecological Footprint measures the evidence of our energy use. The evidence is also called an "impact". Every time we use energy there is an impact. We use energy to get food (our original source of energy), to keep our homes warm and bright, and to move our cars and stuff around. When measuring our *Ecological* Footprint then, we measure not the size of our feet, but the size of the land we use to get our energy from food, fossil fuels and renewable resources.

Last spring we measured the size of the land it takes to grow our food. This summer, we'll measure the size of land it takes to absorb the carbon dioxide (CO_2) that we generate in transportation..

How do I measure my Ecological Footprint?

In this exercise, we'll measure our transportation footprint. When we burn fuels to move our bodies and stuff around in planes, trains and automobiles, a great deal of carbon dioxide is given off (much more than when we use our feet, bicycles and skateboards) so we measure the acreage of plants needed to replace that carbon dioxide with oxygen. We measure this as forested lands, but bogs and oceanic plants help put oxygen in the air too. This area of plants needed to absorb carbon dioxide is sometimes called a *carbon sink.*



Many "renewable " sources of transportation (walking, biking, skating, skiing, horseback riding, sailing, kayaking, canoeing….) produce little or no carbon dioxide while moving us and our stuff around. As there's an insignificant amount of carbon sink needed for these sources, we instead measure the land needed to grow the food to fuel these modes of transportation

In short, fossil fueled electricity impacts are measured by the **forest land** needed to absorb its CO_2 emissions. Solar, wind, hydro-electric and nuclear energy measure their impacts in terms of the amount of **built up** land needed to

It is important to remember:

The carbon sink idea helps us to get an idea of the size of our impacts, but we must remember that *only* planting more trees and preserving forests is not enough because larger forests alone can't make up for all CO_2 emissions we produce.

> "The UN [United Nations] body of 2000 scientists from 100 countries (basically the main body on climate science) is very clear that to allow our climate to re-stabilize ... requires global emissions reductions of 60-80%; and if all the worlds forests were preserved, and barren areas were re-forested, that would account for only 15% of that obligation."
>
> Ross Gelspan (Author of The Heat is On) in an interview with Steve Kerwood of NPR's Living on Earth 11/4/00.

If we *only* plant trees to clean our air of excess CO_2, we'd need four more planets' worth of trees to do the job.

Measuring the difference

host turbines, panels and waste products.

1) To measure the size of land it takes to clean the CO_2 emissions from most of our electricity use, the first thing we're going to need to do is keep track of the electricity we use and where it comes from. To figure out how much electricity you use, ask to see your household electric bill. The bill will tell you how many kilowatt hours (kWh) you and your household use in a month. Divide this by 30 to get a daily household average.

2) To find out where your electricity comes from, ask the person who pays the bill, call your electricity provider, or wander around on the web. http://www.eia.doe.gov/cneaf/electricity/st_profiles/maine/me.html#t7 is a great place to start. You can also look at the average of Maine electricity generation in table 1 or at http://www.eia.doe.gov/emeu/sep/me/frame.html. **Note:** If you have solar panels or a windmill, ask your folks how many kilowatts of electricity your household uses each day.

3) With your daily household average kWh, follow the calculation boxes 1-5 on the footprint page to determine *your* personal electricity use, and impacted land points.

4) To create your "electricity footprint", follow directions on the toes of the footprint page (start with the pinkie toe).

Lighting: Because we use lights so much, let's take a look at how much of our electricity use is lighting. a difference we can make by using efficient light bulbs and turning lights off when we don't need them. For one day, each time you use a light, keep track of what kind of light it is, how many people are using it and for how long. Boxes 6-15 will help you determine the kWh used for lighting. With that number, boxes 1-5 will help you find the land points of that electricity use.

What did you learn about your electricity use?

What percentage of your footprint is filled with electricity points?

How does your electricity impact compare to your food impact?

How much land or clean air would you save if you:
Changed to a different energy source for all of your electricity needs? Changed the light bulbs you use? Turned lights off when not in use?

Repeat this exercise with these changes to learn how it might impact the size of your footprint.

Extensions
Figure out the land impact for each switch in your classroom, and

Table 1
Land Footprint Points per

Generation Source	Land	Points per kWh
Oil	Forest sink	.71
Low altitude Hydro	Built up	.28
Coal	Forest sink	.78
Solar Panels on roofs	None	0.00
Solar farms	Built up	.01
Wind farms	Built up	.01
Nuclear	Built up	.71
Wood	Forest sink	.18
Natural Gas	Forest sink	.64
Average Maine kWh	Forest sink	.45
	Built up	.04

Maine Average based on 1997 information below

53.13%	petroleum	1.28%	natural gas
30.65%	wood/waste	0.97%	coal
13.95%	hydro	0.02%	wind / solar
		0.00	nuclear

Primary Energy Consumed in Maine by Source, 1997

Details available at
http://www.eia.doe.gov/emeu/sep/me/frame.html

Table 2
Lighting

Bulb Type	Watts per bulb	Lumens	Efficiency
T series bulbs are most common in schools.			
T-8 fluorescents	26	T-8 and T-12 produce	
T-12 fluorescents	37	the same amount of light.	
Compact fluorescents	15	900	60 lumens/watt
Compact fluorescents	23	1550	67 lumens/watt
Incandescent	60	900	15 lumens/watt
Incandescent	100	1550	16 lumens/watt
Halogen	45	1100	24 lumens/watt
Halogen	90	2240	25 lumens/watt
Daylight **sunny day**	(measured in foot-candles)		
Daylight **cloudy day**	classrooms need 50 foot-candles		

Lumens measure light levels to help compare bulbs' efficiency.

To figure out if you have enough light without turning on the switch, use a light meter to see what your windows let in at different times of the day on sunny and cloudy days. Light meter reading is part of Green Schools' Energy Patrol training. For info write to PZ at MEEP@NLIS.NET

FOOTPRINT CALCULATOR SHEET

1 point is 1/4 of an acre.

Cut land points to fill squares below, using one color for forest points and another for built up points.

If you made forest points for your food footprint last spring, you can use those points and that footprint.

From the land points you've cut, choose the number of each kind of land point you used (see boxes 1-5). Write the word "electricity" on these points (to identify them from other energy uses) and glue them to your footprint.

For additional instructions, see page 2 and 3 of this insert.

1) Billed kilowatt hours divided by 30 My bill ÷ 30=____	2) divided by the # of people in your household ÷ _________=	3) equals *your* kWh. Now, multiply that by… _________X	4) your land points per kWh (See table 1). __________=	5) These are the land points used for your electricity use. __________

6) For each kind of light bulb you use, multiply the number of	7) watts the bulb uses (from table 2) _________X	8) by the total number of each type of bulb _____=_____	9) multiply this by the number of hours the light was on X_______ hours=	10) take the product of all these numbers … _________

11) divide by the number of people using that light... ÷ _________=	12) the amount of electricity *you* used from this bulb type. ___________	13) Follow steps 6-12 for *each kind of light bulb*, then….

14) add box 11 results from each kind of bulb sum___÷ 1,000=	15) divide this sum by 1000. This is the kWh you use for lighting!

*To figure the land points of electricity you use, follow boxes 1-5.

*To figure the kWh from lighting, follow boxes 6-15.

*To figure out your land points for lighting, use the kWh from box 15, and follow boxes 3-5.

*Mark this # of electricity land points (already glued to your footprint) with the word "lighting" below the word "electricity".

*To figure out how much "carbon sink" is needed for each light switch in your class room, find out how many bulbs one switch turns on. Next, find out what kind of bulbs they are and look up their wattage in table 2.

*Multiply the number of bulbs by the wattage. The product is the total wattage. Divide this by 1,000. The answer is your kWh.

*Multiply kWh by land points (table 1).

*Multiplying land points by 10890 gives you the square feet (by 5.44 to get the number of soccer fields) of carbon sink impacted by that light switch.

This cluster above represents the amount of usable land evenly divided for each person on the planet (1.5 hectares or just under 4 acres). If we're using more than one footprint's worth of land to meet our needs, we're using someone else's fair share. The ecological foot print of people who live in India, for all their needs: food, clothing, transportation & electricity is an average of 4 points (less than 1/4 of a footprint). US Americans' average ecological footprint is 50 points! (more than 3 whole foot prints).

The footprint calculations are based on results from the footprint calculator found at http://www.rprogress.org/progsum/nip/ef/ef_main.html. The soccer field measurements are based on a youth (age 11-12) soccer field size of 60X100 yards. Data on US vs. India footprints from Wackernagel and Rees' book: Our Ecological Footprint: Reducing Human Impact on the Earth.